

Survival and Growth of Puget Sound Chinook Salmon in Response to Climate-induced Competition with Pink Salmon

Gregory T. Ruggerone (Natural Resources Consultants, Inc.; GRuggerone@nrccorp.com),
Frederick A. Goetz (U.S. Army Corps of Engineers; Fred.Goetz@NWS02.usace.army.mil)

We tested for competition between pink and Chinook salmon originating from Puget Sound area rivers using the release of 53.5 million coded-wire-tagged subyearling hatchery Chinook salmon, 1972-1997. Pink salmon have a two-year life cycle, therefore many juvenile pink salmon enter Puget Sound in even-numbered years and very few migrate during odd-numbered years. This odd/even year pattern of abundance provided a natural experimental control. During 1984-1997, juvenile Chinook salmon released during even-numbered years averaged 59% lower survival than those released during odd-numbered years, a trend consistent among 13 Chinook salmon stocks. Lower even-year survival of Chinook salmon was associated with reduced first-year growth and survival, and delayed maturation. In contrast, Chinook salmon released into Washington coast and lower Vancouver Island streams, where few pink salmon occur, did not exhibit an alternating-year pattern of survival. These data suggest the interaction between pink and Chinook salmon occurred within Puget Sound and the lower Strait of Georgia.

Unexpectedly, the survival pattern of Puget Sound Chinook salmon was reversed prior to the 1982-1983 El Nino: Chinook salmon survival tended to be higher when migrating with juvenile pink salmon during 1972-1983. We hypothesize that Chinook salmon survival shifted from predation- to competition-based mortality in response to recent declines in predator (seabirds, dogfish, lamprey, hake) and prey abundances and increases in pink salmon abundance. The apparent reduction in prey of Chinook salmon, as indicated by growth, was associated with a timing shift in peak zooplankton abundance from approximately May to April and a decline in herring abundance, e.g. the late spawning Cherry Point stock. The shift in zooplankton timing may have benefited pink salmon, which migrate to sea relatively early. Alternating-year mortality accounted for most of the 50% decline in marine survival of Puget Sound Chinook salmon between 1972-1983 and 1984-1997. This study provides evidence that reduced growth can influence survival, especially during climatic periods of low prey production. We note that habitat conditions in freshwater, estuarine, and nearshore marine areas may contribute to survival of Chinook salmon in marine waters to the extent that these habitats influence size of Chinook salmon upon entry to epipelagic waters of Puget Sound.